Space Weather Technical Forecast

Issued on Monday, 05 February 2024 at 13:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares expected, with a chance of X-class flares.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity as measured by GOES16 has been Moderate, with several M-class flares observed in the past 24 hours, most originating from AR3576 near the southeast limb. The largest was an M2.7 flare, peaking at 04/2237 UTC. There are currently nine sunspot regions on the visible disc. AR3576 in the southeast is the largest region, with significant magnetic complexity having mixed polarities contained within one large penumbral area, giving it a beta-gamma-delta classification. Another noteworthy sunspot region is AR3575 in the southwest, which is also magnetically complex, with a delta spot clearly evident. A new simple region has rotated around the southeast limb. All other spots have shown little change and remain small.
No clear Earth-directed CMEs have been observed in the past 24 hours, though an eruption from the southeast (likely near AR3576) early on 05 Feb is yet to be analysed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE and DSCOVR at L1, were at ambient to slightly elevated levels, with wind speeds varying between 350-430 km/s. Density was mostly average or below throughout. The IMF (Bt) was weak to moderate, and has recently risen to 10nT. The north-south component, Bz, ranged between +/-7nT. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp0-2) geomagnetic activity, with an Unsettled (Kp3) interval observed at 04/2100-0000 UTC.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is at background levels.
GOES16 high energy (greater than 2MeV) electron flux was at background to moderate levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold on a declining trend. At 05/0000UTC the 24-hour integrated fluence observation was 2.64e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Overall activity is most likely to be Moderate, with further M-class flares expected until Day 4 (08 Feb), when they become likely, and there is a chance of X-class flares until Day 3, when the risk reduces to a slight chance, mainly from AR3576 in the southeast or AR3575 before it rotates off the southwest limb by Day 4.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. Recent solar wind parameters suggest the potential for a weak HSS to be arriving at Earth, which is perhaps linked to CH96/+. Wind speeds perhaps becoming slightly elevated in the coming hours, before easing through Days 2 and 3 (06-07 Feb).
Geomagnetic activity is expected to be mostly Quiet to Unsettled, perhaps with a slight chance of Active intervals Days 1 and 2 (05-06 Feb) with any weak HSS enhancement.

Energetic Particles / Solar Radiation: There is a daily slight chance of proton flux exceeding

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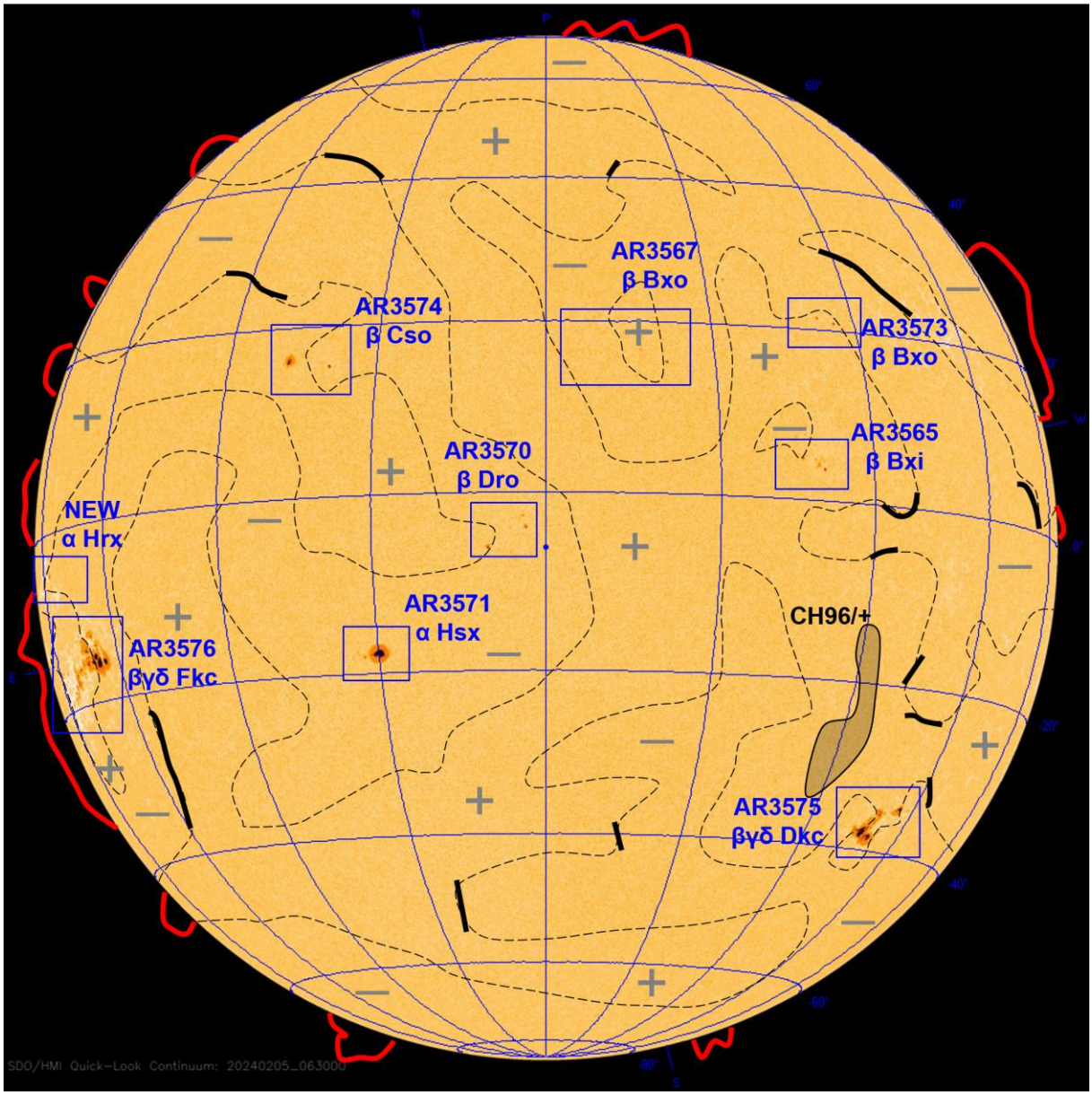
the S1 threshold during the period, especially if any significant flaring occurs from AR3575 in the southwest.
The high energy electron flux (greater than 2MeV) is expected to remain below High levels throughout the period, with exceedance of the Active fluence threshold considered unlikely.

Figure 1. Solar Analysis Valid 05/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs currently feature in the forecast, though an eruption from the southeast (likely near AR3576) early on 05 Feb is yet to be analysed.

Solar winds are now at background levels after a recent CME enhancement. Recent solar wind parameters suggest the potential for a weak HSS to be arriving at Earth, which is perhaps linked to CH96/+. Given this was a weak feature on the previous rotation, similar is likely again this time around with wind speeds perhaps becoming slightly elevated once again in the coming hours, before easing through Days 2 and 3 (06-07 Feb).

Geomagnetic activity is expected to be mostly Quiet to Unsettled, perhaps with a slight chance of Active intervals Days 1 and 2 (05-06 Feb) with any weak HSS enhancement.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs are currently expected.

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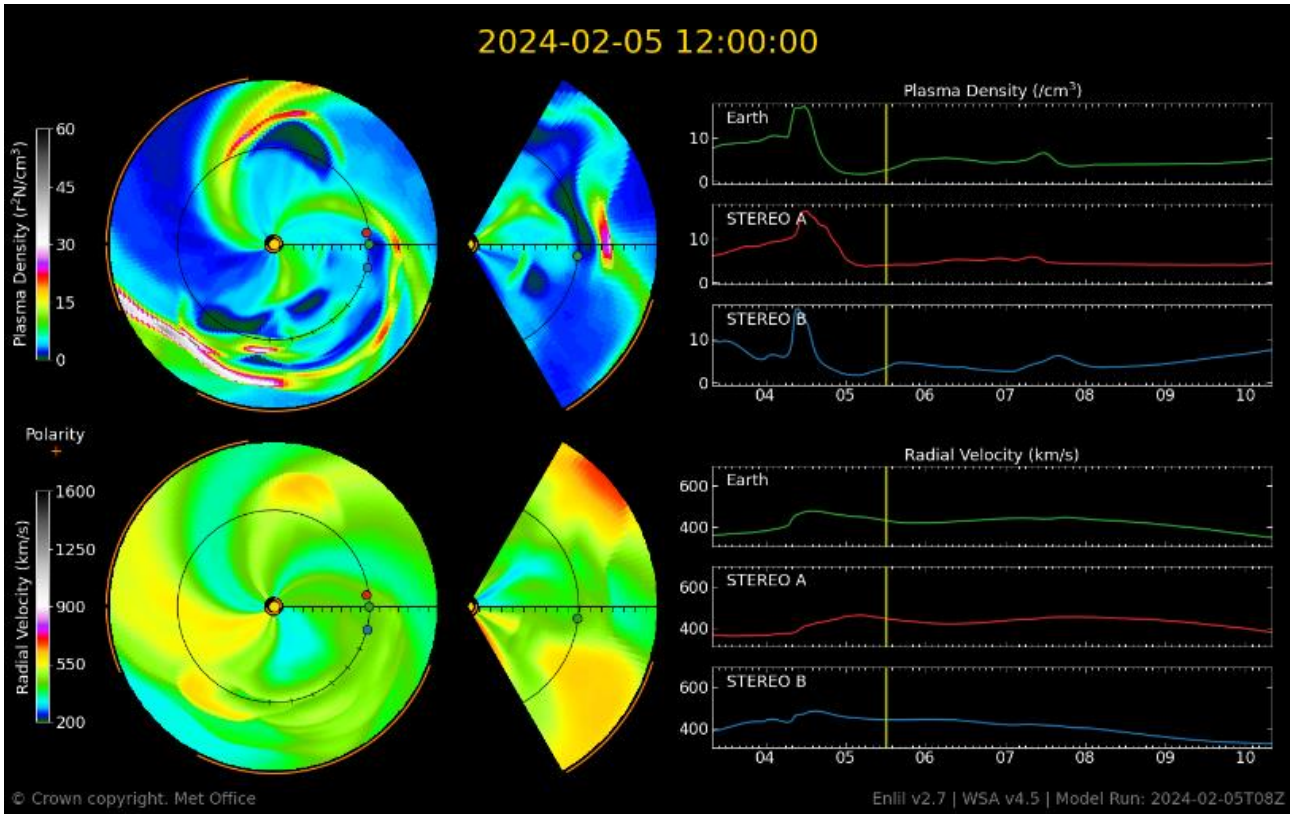
Figure 2: MOSWOC Enlil, showing background to slightly elevated wind speeds.



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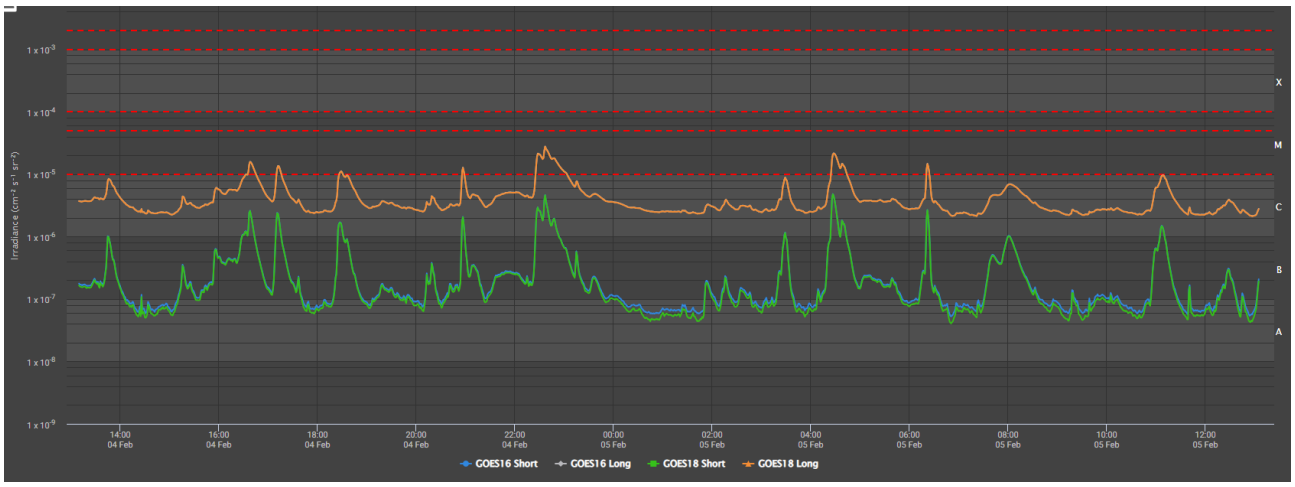
Radio Blackouts - X-Ray Flares:
There are currently nine sunspot regions on the visible disc. AR3576 has now rotated fully into view around the southeast limb. This spot is the largest region on the disc, with significant magnetic complexity having mixed polarities evident contained within one large penumbral area, giving it a beta-gamma-delta classification. This spot has also apparently lengthened as it has rotated into view, most recently becoming an Fkc class. This spot has been responsible for the majority of the low level M-class flares in the past 24 hours. Another noteworthy sunspot region is AR3575 in the southwest, which is also magnetically complex, with a delta spot clearly evident. A new simple region has rotated around he southeast limb. All other spots have shown little change and remain small.

AR3575 will rotate off the disk Day 3 or Day 4 (07-08 Feb). This may be replaced by further regions rotating around the eastern hemisphere later in the week. M-class flares are expected until Day 4 when they become likely, and there is a chance of X-class flares until Day 4 when the risk reduces to a slight chance, mainly from AR3576.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	75	70
Very Active	R3 to R5 X Class	No	25	25	25	20

Figure 3: X-ray trace at GOES16 and 18, showing several M-class flares, mainly from AR3576.



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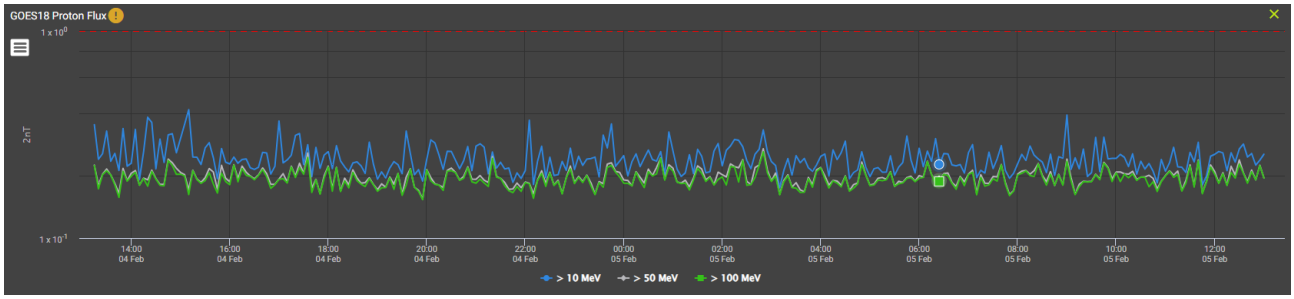
Solar Radiation Storms - (High Energy Protons):
GOES18 high energy (greater than 10MeV) proton flux has returned to background levels. There remains a slight chance of reaching S1 levels should any significant flaring occur from AR3575, which will be in a favourable geo-effective location in the western disc throughout this period. AR3576 in the southeast will rotate towards the centre third of the disc by Day 4 (08 Feb), with a consequent slight increase in the risk of radiation storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: 10MeV proton flux at GOES18, with levels having returned to background.



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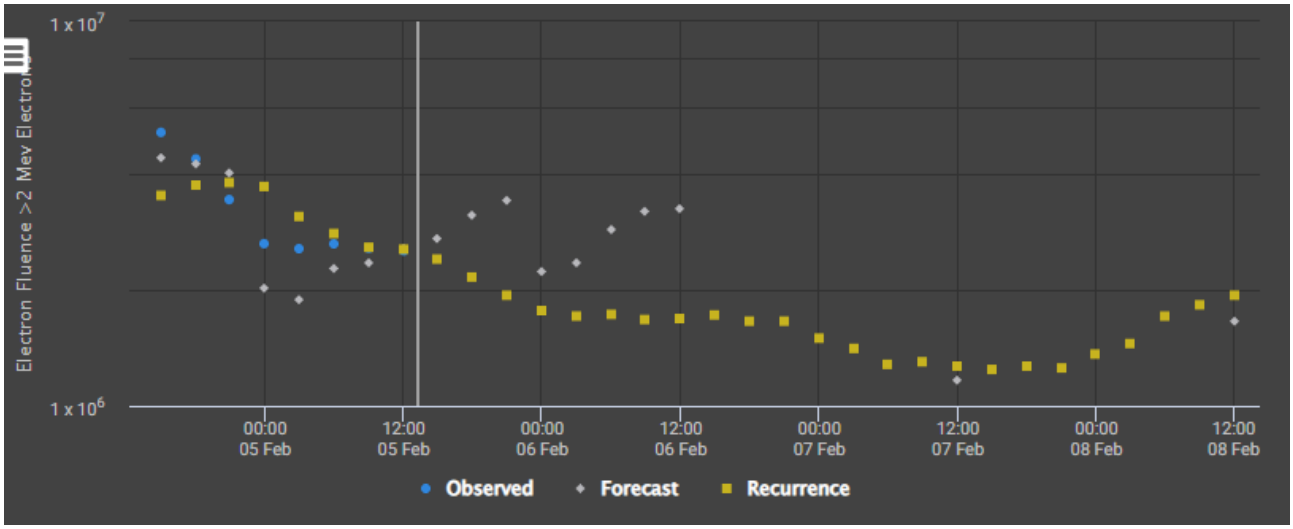
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) has been mostly at background levels. Any CME or HSS effects during this period are most likely to be fairly weak, and lack impetus for a significant increase in electron flux.

Overall, the electron fluence is expected to remain well below the Active (1e8 integrated flux) threshold, as suggested by MOSWOC's REFM, which is considered to be an overall good guide at present.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM, showing a forecast well below the Active threshold.



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